

Appendix A: Regional Sediment Assessment Program Outline

PROPOSED OUTLINE

Regional Sediment Assessment Program for Central Coast Regional Water Quality Control Board

August 2004

Module 1 — Program Guide

- 1) Concept and Purpose of Program
 - a) Concept: a programmatic approach to developing knowledge of water quality conditions affected by sediment, and putting that knowledge in the hands of Regional Board staff.
 - b) Provide tools to develop a clear definition of sediment problems
 - i) Provide a consistent approach to characterizing effects of sediment on beneficial uses
 - ii) A tool for TMDL staff, other staff: Ag-program, stormwater, Nonpoint Source
- 2) The cost of not having an effective assessment and monitoring program is:
 - a) Lacking sufficient information, staff makes erroneous conclusions about the causes and consequences of erosion and sedimentation observed in the field.
 - b) Measures of effects are inconsistent between areas resulting in uneven application of regulatory actions.
- 3) Limitations: emphasizes accurate definition of problem (is sedimentation accelerated and how is it affecting beneficial uses, where a beneficial use is known), not so much identification of its cause (flow alteration, urbanization effects, gravel mining, timber, etc.).
- 4) Program Structure and Components
 - a) Continuous updating and feedback loops (e.g., new protocols developed as our understanding of conditions improves.)
- 5) How to Use Documents and Components
- 6) Schedule and Phases
- 7) Resource Commitments
- 8) Relationship to existing programs (Central Coast Ambient Monitoring Program, Total Maximum Daily Loads, Stormwater, Nonpoint Source, Point Source.)

Module 2 — Guide to Accurate Identification of Sedimentation Impacts in Region

Part I: Background and Key Concepts

- 1) Particle sizes (bed load, suspended load, dissolved load)
- 2) Hydrology
 - a) Flow duration
 - i) Major Patterns: Unregulated, Regulated, Partly Regulated, and Urban Streams
- 3) Stressors
 - a) Natural disturbance regimes
 - b) Anthropogenic: channel modification, flow alteration, vegetation modifications, sinks, etc.
- 4) Water Quality Standards for Sediment

- 5) Beneficial Uses affected
- 6) Criteria for evaluating Beneficial Uses affected
 - a) Lotic systems: rivers, streams, agricultural ditches
 - b) Estuaries, sloughs
 - c) Lakes, reservoirs, ponds
 - d) Harbors and bays
- 7) Indicators of effects on beneficial uses
 - a) Numeric Evaluation Guidelines for 303(d) listing

PART II: FIELD GUIDE TO INTERPRETING WHAT YOU SEE ON-SITE

- 1) Guide to landscape features and landuse affects on erosion and sedimentation
 - a) Dams, gravel mining areas, channel maintenance areas, bridges, highway grades, etc.
 - b) Land management (timber harvest, military or open space reserves, etc.), (product of GIS analysis; could be a screening exercise expressed as risk, source, vulnerability, hazard etc.).
- 2) Method for estimating “background” sediment for different contexts:
 - a) Spatial (i.e., upstream and downstream of a given location),
 - b) Temporal (i.e., before contemporary disturbance (construction site), or before historical disturbance (e.g., before grazing in Salinas Valley, or Morro Bay watersheds).

Module 3 — Sediment Problems in Region 3

- 1) The historic context of erosion and sedimentation in Region 3 (disturbance history)
 - a) Santa Cruz Mountains
 - b) Watsonville Sloughs and Pajaro River Watershed
 - c) Salinas River Watershed
 - d) Morro Bay Watershed
 - e) South Coast and Interior Valleys
- 2) Status of Known problem areas and sites
 - a) Sediment loads calculated for San Lorenzo River, Los Osos Creek, etc.
 - b) Fish habitat impacted by sedimentation
 - c) Dredged waterways
 - d) Turbidity effects on municipal water supplies
- 3) Expected Conditions Analysis
 - a) Introduction to Landscape Stratification approach
 - b) Purpose and products of Expected Conditions Analysis
 - c) Required parameters for Expected Conditions Analysis
 - i) Function of data relied upon, including specific digital coverages (spatial data) and tabular data.
 - ii) Analytical procedures: describe how data are to be manipulated, treated, interpreted.
 - iii) Metadata storage protocol
 - d) Results (Products) key map products, tabular data, and summary analytical reports.

Module 4 — Sediment Assessment and Monitoring Protocols

- 1) Ambient Monitoring for Lotic Systems
 - a) In-stream
 - i) Measurements of Active Bed Matrix
 - (1) Particle Size Distribution
 - (2) Embeddedness
 - (3) Other
 - ii) Measurements of Fine Sediments in Pools
 - (1) Rapid assessment methods
 - (2) V*

- (3) Other
 - iii) Thalweg profile
 - iv) Pool/riffle distribution
 - v) Dominant bedform
 - (1) Confinement
 - (2) Entrenchment
 - vi) Aquatic Insect Production
 - vii) Turbidity
 - viii) Suspended Sediment Concentration
 - ix) Other Protocols Considered
 - b) Watershed/Hillslope/Upland
 - i) Hydrologic Connectivity of Roads
 - ii) Stream Diversion Potential at Road Crossings
 - iii) Other protocols considered
 - 2) Ambient Monitoring for Estuaries, Sloughs, and Lentic Systems
 - a) Water clarity
 - b) Sediment Accumulation
 - c) Aquatic Insect Production
 - d) Other protocols considered
 - 3) Site Investigation, Inspections, and Surveillance Methods
 - a) Visual channel inspections to document sediment accumulation
 - b) Sediment Transport Corridors
 - c) Photo-monitoring
 - d) Other protocols considered
 - 4) Quality Assurance and Control

Module 5 — Data Store and Information Management

- 1) Literature Library
- 2) Sediment Assessment and Numeric Data System
 - a) Electronic data files
 - b) Spatial data files

Module 6 — Staff Training Plan

Appendix B: Protocols for Stream Substrate Sampling

1. PEBBLE COUNT PROTOCOL

CCRWQCB adapted this protocol from the protocol used by the Sotoyome Resource Conservation District Russian River Watershed Volunteer Monitoring Program.

1.1. Objective

Salmonids require gravel bed streams to spawn. The presence of too much fine material can adversely impact the ability of salmon eggs to develop into fry. A pebble count is a method of characterizing the material on the bed of the channel. This method is used for estimating the size distribution of the coarse (>4 mm) rocks on the surface of the channel.

Overview:

This procedure must only be conducted when there is no potential to interfere with spawning or survival of fish after their emergence from gravel as fry. Thus, the protocol is conducted on “potential” spawning gravels, rather than redds. After identifying and demarcating a potential spawning gravel feature (typically a pool tail, or, riffle crest), conduct a pebble count by randomly selecting 100 gravel particles and measuring their intermediate axis in millimeters.

A pebble count cannot give size distribution information about the fine material (less than 4-mm) on the riverbed. Pebble counts also cannot give information about the size distribution of material below the surface layer.

1.2. Field Protocol

Filling out the Data Sheet

It is important to fill out the descriptive information on the data sheet:

- Waterbody name, study reach number, feature number
- Date of sampling, time of sampling, names of monitors
- Draw map on back of data sheet, or, preferably on pre-formatted map sheet
- Remember to remove watches, loose rings etc. before reaching underwater

Drawing the Map

Draw a map of the stream channel where the feature is located. The channel drawing should show the length of the channel for at least the length of the habitat features upstream and downstream of the feature sampled. For example, if the feature sampled is a pool tail-out, the drawing should cover the entire pool upstream and the downstream feature as well.

Face downstream: the stream bank to your left is called the left bank; the one to your right is the right-bank. The left-edge of water and the right-edge of water are determined the same way. Label your map accordingly. Draw the following features on the map.

1. Top and bottom of the banks
2. Bankfull level if clear
3. Direction of flow
4. Left and right edge of water (wetted perimeter)

5. Label the feature you are sampling, including its dimensions
6. Label other features such as pools and riffles
7. Label features that might help identify location or explain morphology (e.g., large trees, adjacent structures, culverts)
8. Indicate distance and direction of beginning of reach (e.g., "33m upstream of feature 1, 38m upstream of beginning of reach.")

Observe the channel. Look for regions with different sizes of rock, gravel and sand (texture). The textural regions are what you are going to draw on the map. Sketch the boundaries between the regions of different sized bed-material. The key to identifying the regions of different texture is to imagine that there is no water in the channel. Part of a textural region may be above the water surface and part may be below the water surface. Focus on the texture of the surface of the riverbed near the feature sampled. Ignore isolated patches that are less than 5 square feet in area. Label each of the textural regions A, B, C etc.

Performing the Pebble Count

Pebble counts are done best by a two-person team. One person selects and measures the stones and the other person records the data. Begin by laying out the measuring tapes with tent stakes to help delineate the feature and to get dimensions for recording on the map.

A pebble count is done by randomly selecting a minimum of 100 stones and measuring the B-axis. Figure 1 shows the three axes drawn on the shape of a stone. The B-axis, also known as the intermediate axis, is the one to measure and record when doing the pebble count. The B-axis determines the sieve opening the stone can just pass through. The stones are selected by walking in the region to be sampled. Be sure to sample any portion of the region that is under water.

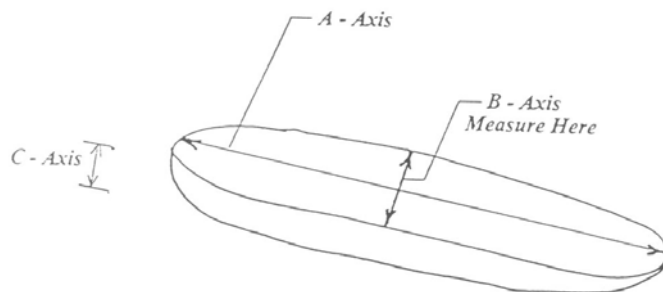


Figure 1. Measuring the stones.

- Take a step into the feature, extend your hand towards the riverbed while averting your eyes away from where you are reaching.
- Use your index finger to touch the bed just in front of the toe of your lead foot. Use the same foot and the exact same part of your finger for the duration of the pebble count.
- Select the first particle touched by your fingertip. Do not look where you are reaching. Looking at the tip of your finger tends to cause people to select larger stones.
- Pick up the particle and measure its B-axis, in millimeters.
- Call out the size to your partner. Your partner will make a tally mark next to the appropriate size class on the data sheet. See the data sheet on the last page of these instructions.
- If the particle is less than 4 millimeters, do not try to measure it. Simply tell your partner, "less than 4 mm."
- If you touch a leaf or stick, move it out of the way and try selecting another rock. Avoid looking at the riverbed by your foot when you discard the leaf.

- If you are unsure if you have picked up the first pebble you touched, drop it and select another one. This is a common problem when sampling underwater.
- After measuring a rock, toss it out of the sampling area. Be careful not to throw the rock into a region that has not been sampled.
- Estimate the size of embedded particles that cannot be removed from the substrate without major disturbance of the surrounding gravel. Typically these particles will be recorded as >256mm.
- Measure only rocks that are clearly in feature you are sampling. Do not sample rocks from near the boundary of the region. Doing so might result in your accidentally crossing the boundary.
- After at least 100 pebbles have been selected and measured, count the number of tally marks in each size class for later entry into the database. The database will compute the cumulative sum and the *percent finer than*

It is important that the measured rocks are selected randomly. There are several ways to do this. One method is to start at the left edge of the region on the upstream end and walk downstream parallel to the bank. At each step select a pebble from beneath the toe of your lead foot. When you reach the downstream end of the region sidestep to your right then turn around. Walk back upstream, sampling as you step. Try adjusting your stride so that you just cover the entire region. If you do not look at the streambed when you are walking, this method will produce a random sample. There are several variations to this method such as walking across the channel instead of downstream.

Clean Up

Remove all the temporary stakes from the channel bed. Remove all the flagging used to mark the bed-material regions. Wind up all of the tapes. Pick up any trash you may have dropped.

Quality Control/Quality Assurance

A within-site variance term for surface material should also be estimated. By randomly dividing the 100-stone sample from a single site in half, two representative replicate samples are obtained. Do this for eight randomly selected sites. For each 50-stone replicate the median grain size is determined, and for each pair the difference of the estimates calculated. These can then be used to provide an estimate of within-site variance of median estimates.

Materials

1. Data Sheets
2. Waders or stream wading shoes
3. Pencils and Clipboard
4. Protocol instructions
5. Two 30-meter waterproof (nylon) measuring tapes
6. Ruler marked in millimeters
7. 6 temporary (tent) stakes

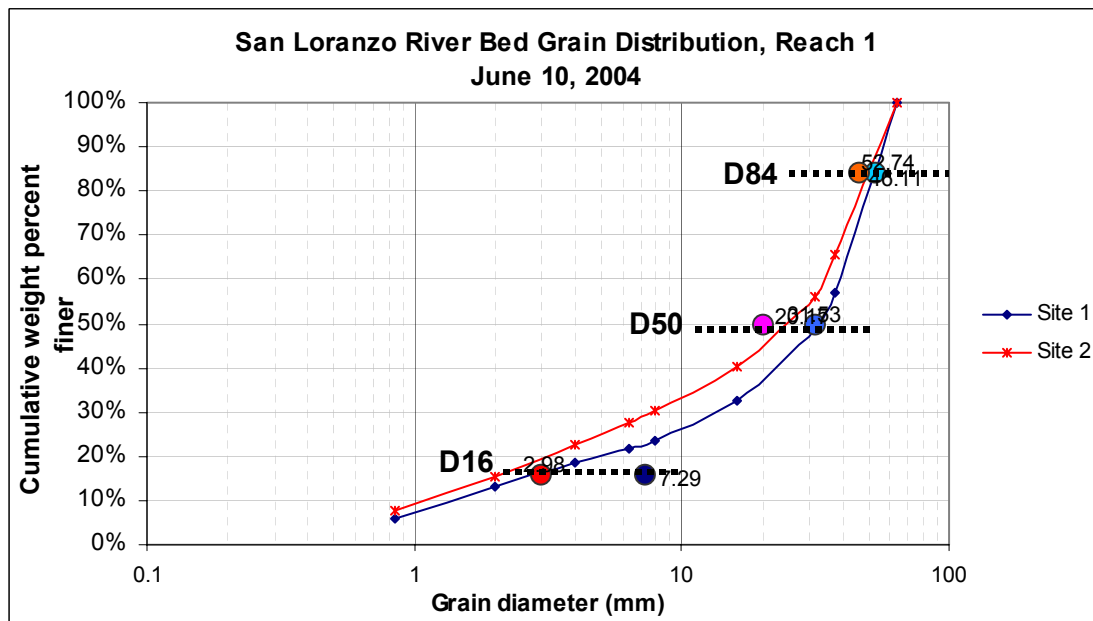
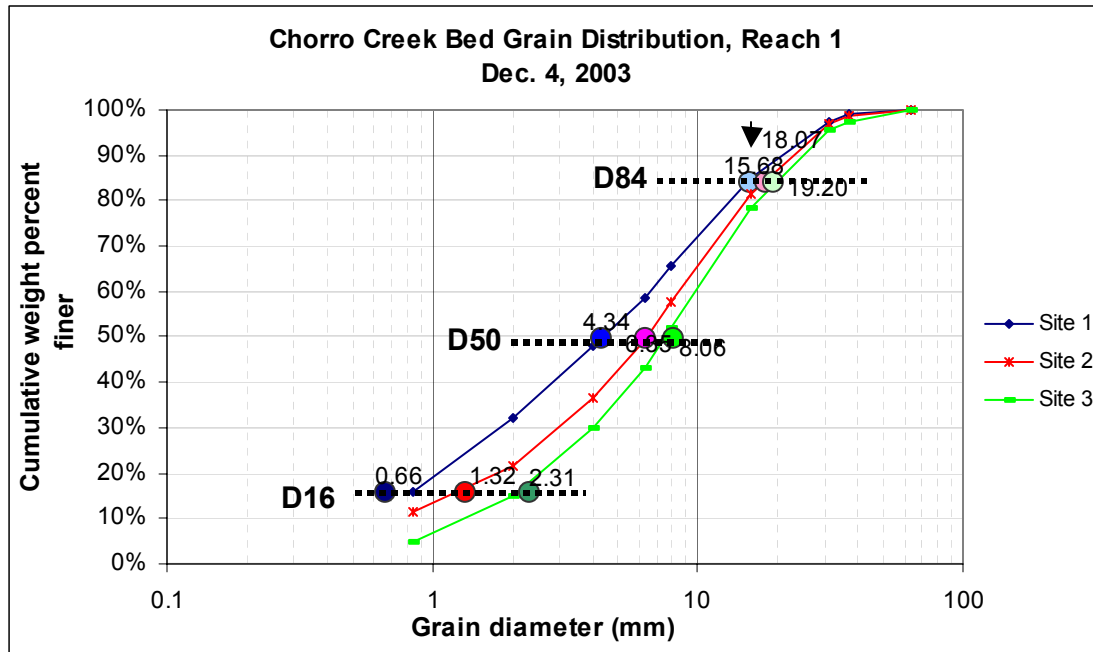
References

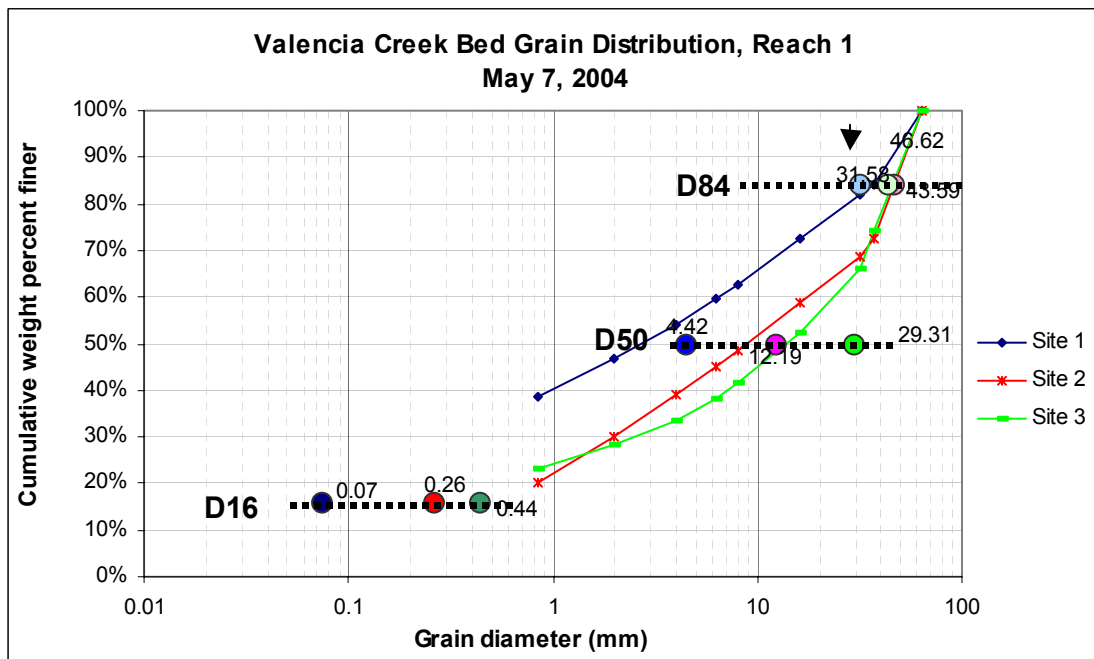
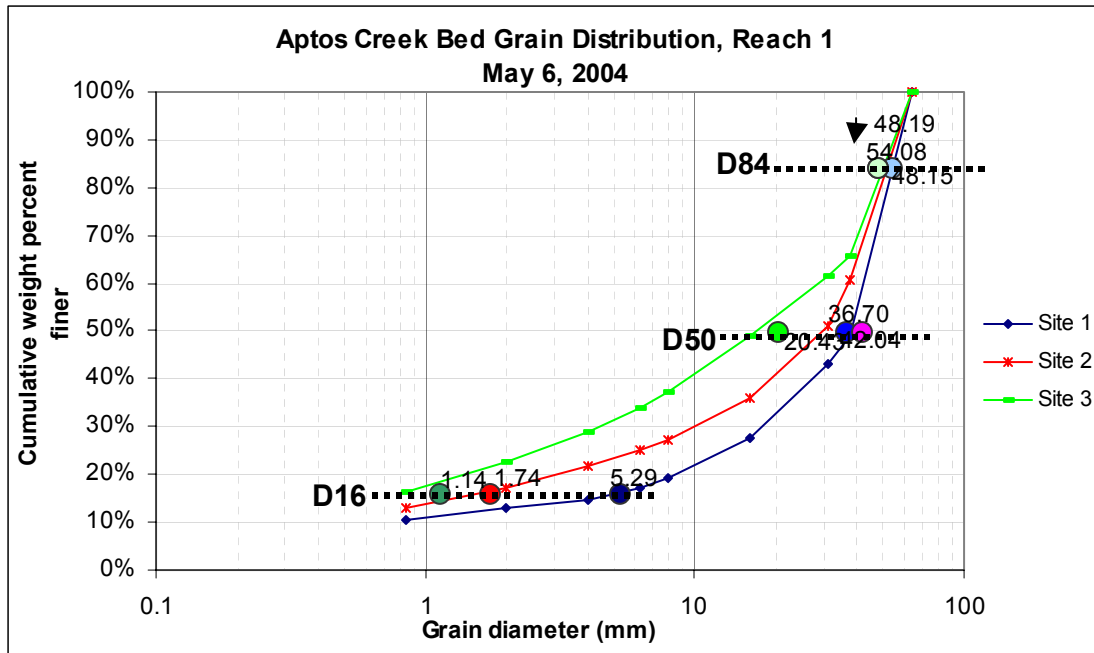
Kondolf, G. Mathais, *The Pebble Count Technique for Quantifying Surface Bed Material Size in Instream Flow Studies*, Rivers, Volume 3, Number 2, pages 80-87, April, 1992,

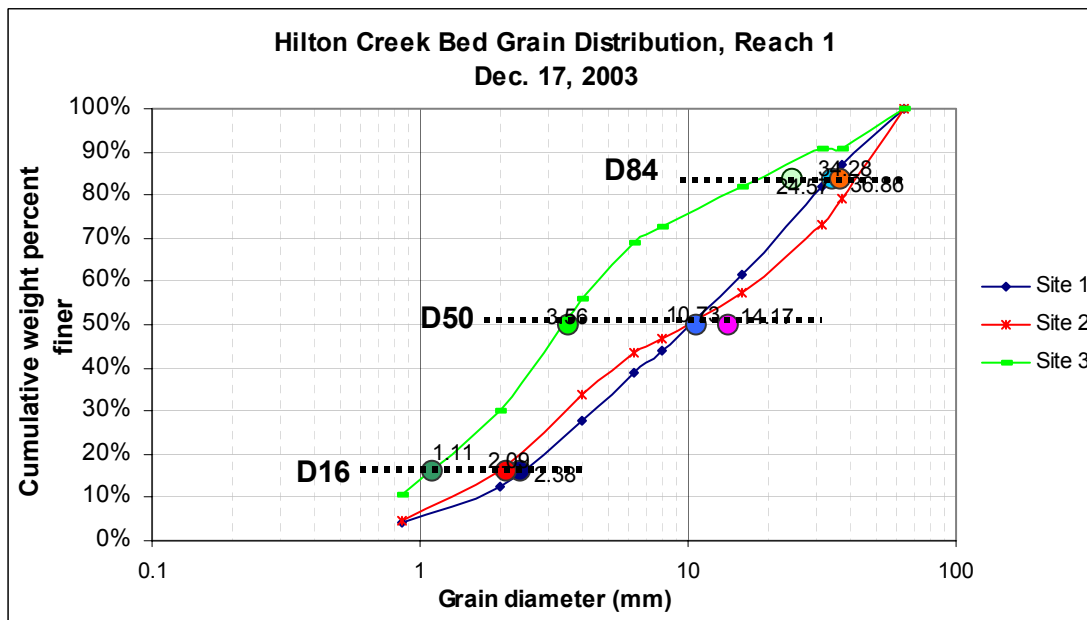
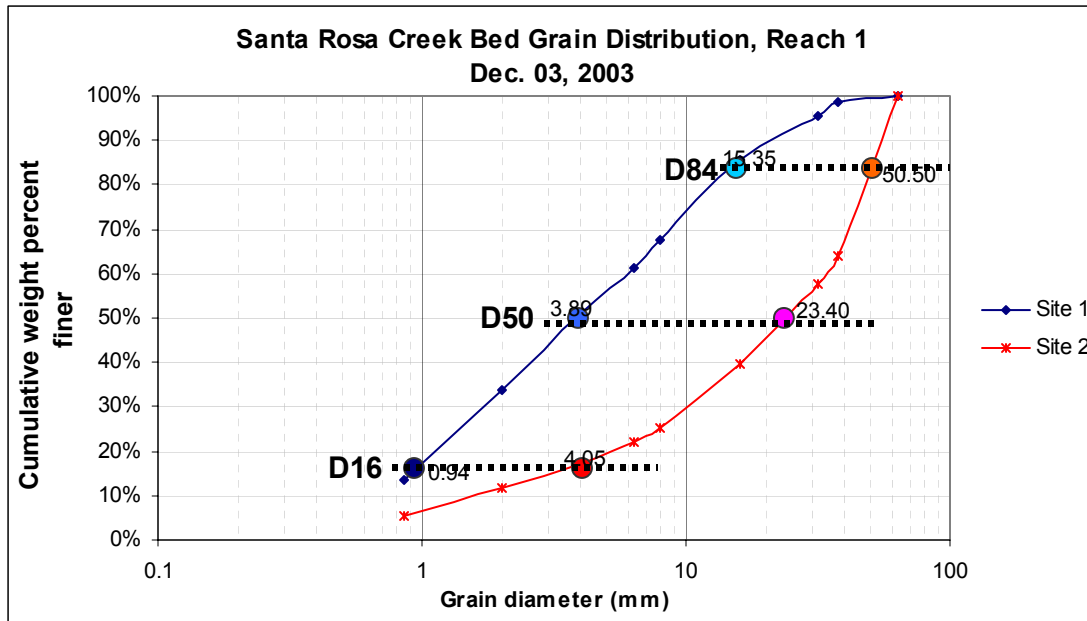
Leopold, Luna B., *A View of the River*, Harvard University Press, Cambridge, MA, 1994.

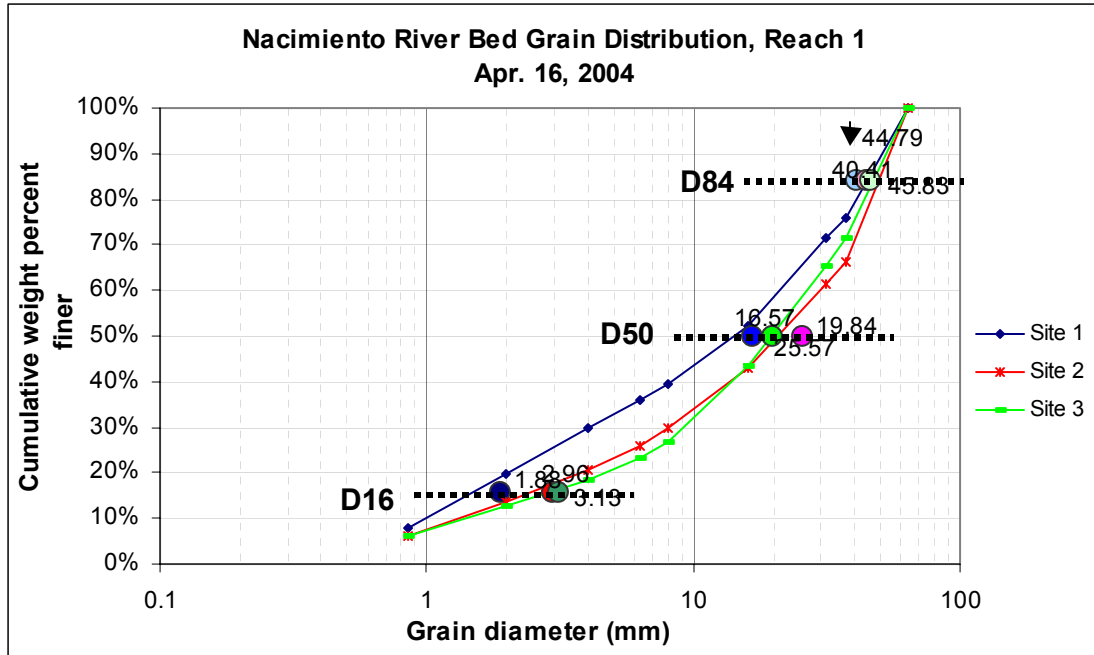
Wolman, M. Gordon, *A Method of Sampling Coarse River-Bed Material*, Transactions of the American Geophysical Union, Volume 35, Number 6, December 1954.

Appendix C: Cumulative Frequency Curves for Potential Spawning Gravels in Region 3









Appendix D: TetraTech's Review of Regional Sediment Assessment Program and Module 4, Phase 1

Appendix E: Previously Developed Site Selection Criteria

Note: The following was excerpted from: Procedures for Sediment Assessments, Version 1.0, May 2002, CCRWQCB.

Objective of Procedure:

To quantitatively describe the characteristics of sediment in areas used by coho and steelhead. Gravel size (bulk sample and pebble count) and filling of pools by fine sediment (V^*) are measured.

This procedure was developed for both assessment and TMDL monitoring purposes for the Central Coast Regional Water Quality Control Board. Questions and additional information can be obtained from RWQCB staff: Mark Angelo and Dominic Roques.

Sampling Site Selection Criteria:

Repeatability of the methods in this procedure is improved greatly by confining the universe of conditions to which they are applied¹. Where possible, attempt to make the measurements in one pool-riffle feature, i.e., measure gravels in the pool riffle crest below the pool where V^* is measured. The following are reach- and site-specific criteria for selecting the locations to take measurements:

1. Gradient: Sampling of the substrate should be limited to locations where both gross gradient (measured by USGS quad) and site gradient are less than 3%. Site gradient is measured in the field with the sampling location $\frac{1}{2}$ the distance between the upstream and downstream reach $> 5x$ the full channel width.
2. Sites should be spaced fairly evenly between major confluences so that the influence of tributary sediment inputs can be assessed. Confluences are often associated with discrete changes in bed material texture.
3. Stream Order: Streams to be sampled should be restricted to 5th order or smaller.
4. A pool is outlined by its residual water surface, so backwaters with connections deeper than the riffle crest depth should be included in the pool.
5. Areas under undercut banks, logs, logjams & etc are also part of the pool. The easiest way to measure these places is often with a short stick.
6. Pool/Riffle Break: This area is defined as the upstream portion of the riffle where the gradient begins to steepen and white water begins to appear. It is characterized by the riffle crest, a distinct feature located at the transition between pool tailouts and riffles. The riffle crest is the high point on a longitudinal profile and usually the shallowest place at the downstream end of a pool.

¹ "The population of spawning areas varies widely between streams. In some, the population is so small that a 100 percent sample of mappable areas is required to obtain a sample of several. In others, the population is large enough to be sampled randomly. Spawning requirements for substrate and hydraulic conditions preclude much of the variation between areas of a stream channel and thus automatically reduce the expected variation in scour and fill, as well as sediment infiltration, between spawning areas. A reasonable sample of spawning areas may number from five to ten depending on level of significance." (Lisle, T.E. and Eads, R.E., 1991. Methods to measure sedimentation of spawning gravels. Research Note PSW-411. Berkeley, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; p. 5.).

7. Location used by fish, but not an active redd. For coho streams, candidate sites would have a) dominant gravels between 1 and 20 cm (pea to orange sized), b) contiguous area at least two meters square.
8. Avoid sites immediately downstream of major logjams.
9. Access and Safety.

Sampling Site Sketch Map and Photo:

Sketch the site where measurements are taken. Include key features of bank, substrate and channel configuration. Identify where bulk samples were collected and the location of the array of V^* cross-sections (a more detailed map of the array and pool features will be prepared for the V^* procedure (See example Sketch Map). Take a photo during the procedure making sure to encompass the entire site. Use site name placard (large letters on sheet on clipboard) to identify photograph.

When to Sample:

Summer low-flow.